THE SUBMILLIMETER TELESCOPE OBSERVATORY

ROBERT N. MARTIN
SMTO/Steward Observatory
University of Arizona
Tucson, AZ 85721

1. Introduction

The Steward Observatory of the University of Arizona and the Max-Planck-Institut für Radioastronomie (Germany) have collaborated on the construction and operation of a dedicated submillimeter telescope facility. The Submillimeter Telescope Observatory (SMTO) has been formed to operate the facility for the two partner institutions. The facility is located at an altitude of 3200 meters on Mt. Graham in southeast Arizona. The 10 m diameter telescope is an alt-azimuth mounted f/13.8 Cassegrain homology telescope with two Nasmyth foci. The telescope has diffraction limited performance at a wavelength of 300 microns. During the last year, the telescope reflector surface has been adjusted to 20 microns rms and initial astronomical observations have begun.

2. Telescope and Enclosure

The telescope is a 10 m diameter on-axis Cassegrain design with a paraboloid primary and a hyperboloid secondary mirror. We have chosen a rather fast primary mirror (f/0.35) and a small 690 mm diameter secondary. This reduces the telescope axial dimension and minimizes the size (and cost) of the enclosure which is required to protect the telescope from weather damage.

An important feature of the telescope is the construction of the primary and the secondary reflectors out of aluminum core, carbon fiber reinforced plastic (CFRP) face sheet sandwich panels. In addition, the reflector backup structure and the secondary support are made of CFRP structural elements. This design route was chosen because of the low thermal coefficient of expansion and the high strength-to-weight ratio of CFRP. The

result is a telescope which meets the required precision for both day and night operation.

The SMT enclosure is designed to protect the telescope from precipitation and high winds which could damage the reflector surface. We have designed a corotating enclosure which, additionally, provides (a) control rooms, (b) convenient access to the telescope at several levels for maintenance, and (c) large instrument rooms with easy access to the telescope foci.

Further details of the SMT design can be found in Martin and Baars (1990).

3. Construction Schedule

The recent telescope and enclosure construction is summarized below.

1990	-	Summer:	site work commences, telescope fabricated
1991	-	Summer:	start concrete work on site
1992	-	October:	start assembly of telescope mount on site
1993	-	August:	enclosure and telescope assembly completed
1993	-	September:	formal dedication of telescope and enclosure
1994	-	February:	first light at 1.2 mm wavelength
1994	-	June:	first holography session to set reflector surface
1994	-	September:	second holography session
1994	-	December:	first light at 0.3 mm wavelength
1995	-	March:	third holography session; reflector rms=20 μm
1995	-	April:	preliminary visitor observing tests
1996	-	January:	regular visitor observing begins

4. Reflector Surface Setting

Considerable time has been spent in the last year to set the reflector surface and to tune up the telescope drive servo system. The surface has been set by using the holographic method with the 38 GHz radio beacon of LES-8 (Mayer et al. 1994). The holographic receiver frontend was borrowed from NRAO Tucson. A special digital logging and data handling backend was developed and built for this experiment by the SMTO.

After several iterations of measurement and surface setting, the reflector is now set with an rms accuracy of 10 microns for ring 1, 15 microns

for ring 2, and 25 microns for ring 3. The overall average is 20 microns if weighted by surface area. We believe that this is now the most accurate radio telescope of its size class. The current setting accuracy has been limited by a small instrumental crosstalk in the electronics. We have improved the electronics since the last holography session and expect to pursue further holographic measurements to improve the surface setting. We expect that the instrumentation will now allow measurement accuracy well beyond the surface setting goal of 15 micron or better rms.

A small number of high frequency observations have been made from April 1995 through April 1996. These measurements confirm the reflector surface quality. In addition, daytime measurements confirm the excellent telescope stability even with significant solar heating to the structure.

References

Martin, R. N., & Baars, J. W. M. 1990, "The Submillimeter Telescope (SMT) Project," *Proc of SPIE*, **1235**, 503-514

Mayer, C. H., Emerson, D. T., & Davis, J. H. (1994) *Proc. IEEE*, **82**, 756-762